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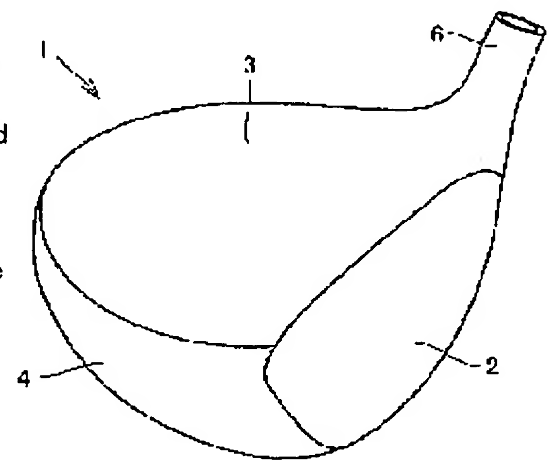
(54) WOOD GOLF CLUB HEAD AND WOOD GOLF CLUB

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an wood golf club head and wood golf club which generates comfortable ball-hitting sound and by which it is easily judged whether ball-hitting action and a hitting point are good or not.
SOLUTION: The head 1 of the wood golf club is provided with a face part 2, a crown part 3, a side part 4, a sole part, and a neck part 6. The ratio of a primary natural frequency in the state of restraining the center part of the face part 2 to that in the state of not restraining the head 1 meets n: n+1 (n is an integer ≥1 and ≤3). Desirably, the value of the ratio is 1:2 or 2:3.



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CLAIMS

[Claim(s)]
[Claim 1] The wood golf club head which made the ratio of the primary resonant frequency in the condition of having restrained the center section of the face section (2) of a golf club head, and the primary resonant frequency in the condition of the head concerned of not restraining n:n +1 (n is or more 1 three or less integer).
[Claim 2] The wood golf club head which made said ratio 1:2 or 2:3.
[Claim 3] The primary resonant frequency in the condition of having restrained the center section of said face section (2) is a 600Hz or more wood golf club head according to claim 1 or 2 which is 1200Hz or less.
[Claim 4] The wood golf club head according to claim 3 whose volume of said head is three or less [500-cm / 3 or more / 300cm].
[Claim 5] A wood golf club head given in either of claim 1 to claims 4 which set to 1:3 the ratio of the primary resonant frequency in the condition of having restrained the center section of said face section (2), and the resonant frequency in the oscillation mode related to the SOL section (5) in the condition of the head concerned of not restraining.
[Claim 6] A wood golf club head given in either of claim 1 to claims 5 which set to 1:n (n is or more 3 five or less integer) the ratio of the primary resonant frequency in the condition of having restrained the center section of said face section (2), and the resonant frequency in the oscillation mode related to said face section (2) in the condition of the head concerned of not restraining.
[Claim 7] The wood golf club which equipped either of claim 1 to claims 6 with the head of a publication.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the wood golf club equipped with the wood golf club head and this head which can improve the hit ball sound at the time of carrying out the hit ball of the golf ball about a wood golf club head and a wood golf club.
[0002]
[Description of the Prior Art] In recent years, importance is attached to the hit ball sound of a golf club, and various improvement proposals are made. Moreover, a hit ball sound tends to become large with enlargement of a golf club head. In addition, since the hit ball sound which can be heard at the time of a hit ball gives various information, such as not only the right and wrong of a golf club head but hit ball actuation, right and wrong of a hit ball point, etc., even to the thing of not only a hit ball person but a perimeter, it can be said that the importance of the tone of a hit ball sound is increasing also from such a viewpoint.
[0003] Although various proposals are made from the former about the improvement of a hit ball sound, a thing given in each following official report is in it.
[0004] For example, the manufacture approach of the golf club wood made from titanium which raised the hit ball sound reverberation nature of a 6-8kHz frequency band is indicated by JP,10-179817,A by choosing appropriately the quality of the material and the heat treatment conditions of a face member.
[0005] By choosing appropriately the quality of the material and the heat treatment conditions of a face member, the hit ball sound reverberation nature of a 6-8kHz frequency band is raised, and the manufacture approach of the golf club wood made from titanium which made low hit ball sound reverberation nature of a 4-6kHz frequency band is indicated by JP,10-179818,A.
[0006] The manufacture approach of the golf club wood made from titanium which raised the hit ball sound reverberation nature of a frequency band (4-6kHz and 8-10kHz) is indicated by JP,10-179819,A by choosing appropriately the quality of the material and the heat treatment conditions of a face member.
[0007] In the measuring method by impact testing, as it is in the range whose peak frequency of an impact sound is 4500-8000Hz and the peak sound pressure of the peak frequency of this impact sound shows more than 78dB (A), the golf club which constituted the blow principal part thru/or the whole is indicated by JP,2000-300700,A.
[0008]
[Problem(s) to be Solved by the Invention] Also although it says that the hit ball sound of a golf club is short, before stopping being able to decrease and hear, it will take about about 0.5 seconds, and the items are first divided roughly into a ball, the loud blow sound made by the collision of a head, and the reverberation sound mainly according to a head after the ball following it separates from a head.
[0009] Although the energy of a hit ball sound is brought to a head by the collision of a ball and a head, the head is in the condition that the ball was pushed by the big force at the time of a collision in the meantime at the RBI of a face side. Then, a ball separates from a head and a head emits the reverberation sound which various sounds, such as a sound of other components

which are attached to heads, such as a shaft, focusing on the sound of the frequency of the own resonant frequency of a head at this, joined. These whole sound is put together and it becomes a hit ball sound.
[0010] By the way, although a sound is generated because a body vibrates, generally, the body has the oscillation mode and vibration frequency of some of the body proper which are easy to vibrate, and is calling it the resonant frequency. No matter who may strike by what strength, a tuning fork always makes the sound of the same height (frequency), or it uses this principle that a guitar etc. makes the sound of the half-wave length of the die length of that bowstring or the height of one wave of frequency. In addition, although a frequency and vibration frequency are the almost same semantics, when are related with a sound or an electric wave and a frequency is related with a body, vibration frequency is used in many cases.
[0011] Moreover, when asking some single sounds from which fundamental frequency differs to coincidence, and those fundamental frequency makes an easy integer ratio, the clear feeling of clear sound is produced. At this time, in harmony [those sounds] is said and that combination is called consonance. On the other hand, when fundamental frequency has shifted from the easy integer ratio, the unpleasant sensibility which became muddy is received. At this time, a sound and calls that combination a dissonance.
[0012] For example, when the ratio of the fundamental frequency of two single sounds is 1:2, the chord of the octave on music and 2:3 become pure 5 degree, and 3:4 becomes the chord of pure 4 degree. However, the degree of consonance becomes low, so that a ratio becomes less easy. Moreover, it is known that not only two sounds but three sounds will turn into a chord suddenly as used in the field of [the integer ratio of easy or more 2 five or less natural number] music, and will turn into a more comfortable sound.
[0013] As mentioned above, the resonant frequency of various kinds of oscillation modes of the head in the condition that the sound of the resonant frequency of various kinds of oscillation modes in the condition of a face side of having restrained the central part mostly is to a base at first, and a hit ball sound does not have constraint after that is a basic sound.
[0014] Therefore, although a hit ball sound will turn into a natural comfortable sound, without producing a dissonance until it results [from the standup] in convergence if it is the sound of the first portion at the time of carrying out a hit ball and an integer ratio with the easy vibration frequency of the sound of the section, 2:3 [for example,], and 1:2 in the second half In addition to becoming a jarring dissonance and giving a golfer displeasure, with the head from which the resonant frequency shifted [ratios / these], a hit ball sound will make remarkably difficult the quality of an RBI, and a judgment of the so-called nice shot.
[0015] This invention is made in order to solve this technical problem. The purpose of this invention emits a comfortable hit ball sound, and is to offer the wood golf club head and wood golf club which can also make easily hit ball actuation and a judgment of the right and wrong of an RBI.
[0016]
[Means for Solving the Problem] The wood golf club head concerning this invention is characterized by making into n:n +1 (n being or more 1 three or less integer) the ratio of the primary resonant frequency in the condition of having restrained the center section of the face section, and the primary resonant frequency in the condition of the head concerned of not restraining.
[0017] By considering relation between the primary resonant frequency in the restricted condition of a head, and the primary resonant frequency in the condition of a head of not restraining as the relation of an integer ratio as mentioned above, the sound emitted from the head of a restricted condition and the sound emitted from the head in the condition of not restraining can be made in harmony, and a hit ball sound can be made [sound / near] into a consonance or it.
[0018] Preferably, the value of the ratio concerned is made into 1:2 or 2:3. That is, the primary resonant frequency in the condition of not restraining is made into the twice of the primary resonant frequency in the condition of having restrained the center section of the face section, or 1.5 times. in addition, the case where it considers as less than (relation of an octave) 2.0**0.1

times, or less than (pure -- five relation) 1.5**0.1 times -- parenchyma -- it is the same.
[0019] In this case, the sound emitted from the head of a restricted condition and the sound emitted from the head in the condition of not restraining can be considered as the relation of an octave, or the relation of pure 5 degree. Therefore, these sounds can be made in harmony and a hit ball sound can be made [sound / near] into a consonance or it.
[0020] The primary resonant frequency in the condition of having restrained the center section of the face section is 600Hz or more 1200Hz or less preferably. Moreover, the volume of a head is three or less [500-cm / 3 or more / 300cm] preferably.
[0021] It is desirable to set to 1:3 the ratio of the primary resonant frequency in the condition of having restrained the center section of the face section, and the resonant frequency in the oscillation mode related to the SOL section in the condition of the head concerned of not restraining. That is, the resonant frequency in the oscillation mode related to the SOL section in the condition of not restraining is made into 3 times of the primary resonant frequency of a restricted condition. In addition, it is real identitas if it is less than 3**0.2 times. Moreover, "the oscillation mode related to the SOL section" is the oscillation mode (for example, drawing 12 , the modes 3 and 4 shown in 13) in which the SOL section is uneven.
[0022] Moreover, it is desirable to set to 1:n (for n to be or more 3 five or less integer) the ratio of the primary resonant frequency in the condition of having restrained the center section of the face section, and the resonant frequency in the oscillation mode related to the face section in the condition of the head concerned of not restraining. That is, the resonant frequency in the oscillation mode related to the face section is made into 3 times of the primary resonant frequency in a restricted condition, 4 times, or 5 times. In addition, the case of less than 3**0.2 times, less than 4**0.2 times, and less than 5**0.2 times is also real identitas. Here, "the oscillation mode related to the face section" is the oscillation mode (for example, mode 5 shown in drawing 14) in which the face section is uneven.
[0023] Moreover, a hit ball sound can be made into a consonance much more effectively by considering the resonant frequency of the oscillation mode in which the SOL section is uneven with the resonant frequency of the oscillation mode in which the face section is uneven as the primary resonant frequency in a face restricted condition and the primary resonant frequency of the head in the condition of not restraining, and consonant relation. For example, a hit ball sound can be made [sound / near] into a consonance or it by setting to 1:2:3:4 the resonant frequency of the head in the oscillation mode related to the primary resonant frequency in a face restricted condition, the primary resonant frequency of the head in the condition of not restraining, and the SOL section in the condition of not restraining, and the resonant frequency of the head in the oscillation mode related to the face section in the condition of not restraining.

[0024] The wood golf club of this invention is equipped with an above-mentioned golf club head. The golf club which emits a consonance or the sound near it by that cause at the time of a hit ball is obtained.
[0025]
[Embodiment of the Invention] The wood golf club of this invention is equipped with a head, a shaft, and a grip. A head is metal and has the face section, the crown section, the side section, and the SOL section. A shaft and the thing of the common knowledge as a grip are adopted.
[0026] In this invention, the rigidity of each part is changed by changing the thickness and the elastics modulus of each part in a wood golf club head, such as the face section and the crown section. The resonant frequency in each oscillation mode is changed by that cause. The resonant frequency of the head at the time of face section constraint, the resonant frequency of the head at the time of un-restraining (free) is changed -- making -- the ratio -- 1:2 and 2: -- it is made to generate a natural and comfortable hit ball sound by making it the relation of chords, such as 3 and 3:4
[0027] Here, it is in the condition of not restraining the head at all, at "the time of un-restraining", and it is in the so-called condition of free vibration. On the other hand, the condition that adhesion immobilization is carried out and heads, such as the time of resonant frequency measurement, are excited to vibration exciter in the center of the face section is

called the condition of forced oscillation.
[0028] The resonant frequency of the head at the time of face section constraint can be measured by fixing the center of the face section to vibration exciter with adhesives etc., and scanning resonance frequency. Moreover, rigidity, such as a neck edge of a head, can hold a head using the yarn which does not almost have rigidity very highly in comparatively few parts of effect, and can change a head in approximation into the condition of not restraining, and the resonant frequency in the condition of not restraining [of a head] can stick a minute acceleration sensor on each part of a head, and can measure a resonant frequency.
[0029] The invention-in-this-application person etc. used the characteristic value analysis software of the finite element method of pro-MEKANIKA (PANAME trick technology corporation company make) this time in order to evaluate the oscillation mode and the natural frequency of a wood golf club head in a detail.
[0030] The data for analysis considered mesh division size as automatic setting at the mesh for analysis using the shell element using the surface of the neutral plane of each sides, such as a face side and a crown side, and association between each field was considered as the joint share.
[0031] And various kinds of oscillation modes of the head concerned and the resonant frequency of those can be analyzed and computed by setting the thickness of each part as arbitration, and setting up the elastic modulus of the ingredient, and setting up a constraint.
[0032] For example, in a titanium metal wood with light-gage hollow structure, the thickness of each part of the face section, the crown section, the side section, the SOL section, and the neck section is set up, the specific gravity and elastic modulus of a titanium ingredient are inputted, if the conditions which restrain the center of the face section are set up, the resonant frequency of the head in a face section restricted condition is computable, and if it carries out without constraint, the resonant frequency of the head in the condition of not restraining is computable.
[0033] In the titanium wood-head whose volume is about [300cm] three as an example In the case of the face section thickness of 2.8mm, the crown section thickness of 1.0mm, the side section thickness of 1.0mm, and 1.2mm SOL section thickness, the resonant frequency of the head in a face section restricted condition 1058, 1919, 2576, 3122, 3521, 3942, 4622 -- The resonant frequency of the head in the condition of not restraining is 1937, 2615, 3194, 3548, 3903, 4531, and 4940 at Hz. -- It is set to Hz.
[0034] At this time, the primary resonant frequency of the head in the condition of not restraining is 1.83 times the primary resonant frequency of the head in a face section restricted condition, and does not necessarily have consonant relation.
[0035] So, with the wood golf club head concerning this invention, the ratio of the primary resonant frequency in the condition of having restrained the center section of the face section, and the primary resonant frequency in the condition of the head concerned of not restraining is made into the easy integer ratio +1 (n is or more 1 three or less integer), for example, n:n.
[0036] Preferably, the ratio of the primary resonant frequency in the condition of having restrained the center section of the face section, and the primary resonant frequency in the condition of the head concerned of not restraining is made into 1:2 or 2:3. That is, the primary resonant frequency in the condition of not restraining is made into the twice (relation of an octave) of the primary resonant frequency in the condition of having restrained the center section of the face section, or 1.5 times (relation of pure 5 degree). In addition, it is real identitas also when it considers as less than 2.0**0.1 times or less than 1.5**0.1 times.
[0037] Relation between the sound emitted from the head of a restricted condition and the sound emitted from the head in the condition of not restraining can be considered as consonant relation, for example, the relation of an octave, or the relation of pure 5 degree by making into the above-mentioned thing relation between the primary resonant frequency in the restricted condition of a head, and the primary resonant frequency in the condition of a head of not restraining. Therefore, the wood golf club which can make [sound / near] a hit ball sound a consonance or it, and emits a comfortable hit ball sound, and can also make easily hit ball actuation and a judgment of the right and wrong of an RBI is obtained.

[0038] The primary resonant frequency in the condition of having restrained the center section of the face section is 600Hz or more 1200Hz or less preferably.
[0039] Since rigidity is high, the wood golf club head on which the primary natural frequency at the time of face constraint exceeds 1200Hz does not have so loud a hit ball sound from the first. Therefore, the consonant effectiveness mentioned above is not so much expectable. On the other hand, if the primary resonant frequency at the time of face constraint is less than 600Hz, the rigidity of a head will become low and it will be thought that it has the influence which is not desirable in respect of reinforcement, resilience ability, etc. Therefore, a hit ball sound can be made [sound / near] into a consonance or it by making the primary resonant frequency at the time of face constraint into the above-mentioned range, controlling the fall of the reinforcement of a head, resilience ability, etc.
[0040] The volume of the above-mentioned head is three or less [500-cm / 3 or more / 300cm] preferably. Usually, since head mass will be mostly determined by relation with elements other than a head, head mass cannot be increased even if it enlarges the head volume. Therefore, as the head volume becomes large, the thickness of each part of a head becomes thin, and a hit ball sound becomes larger. Therefore, when the head volume is enlarged or more [300cm] with three, the consonant effectiveness mentioned above becomes remarkable. When the volume of a head exceeds 3 500cm, the center of gravity of a head becomes high too much, or each part thickness of a head becomes thin too much, a hit ball sound becomes extremely large, and it becomes however, rather less desirable.
[0041] It is desirable to set to 1:3 the ratio of the primary resonant frequency in the condition of having restrained the center section of the face section, and the resonant frequency in the oscillation mode related to the SOL section in the condition of the head concerned of not restraining. That is, the resonant frequency in the oscillation mode related to the SOL section in the condition of not restraining is made into 3 times of the primary resonant frequency of a restricted condition. In addition, it is real identitas if it is less than 3.0**0.2 times. Moreover, "the oscillation mode related to the SOL section" is the oscillation mode (for example, drawing 12 , the modes 3 and 4 shown in 13) in which the SOL section is uneven.
[0042] Thus, while making consonant relation the primary resonant frequency in a face restricted condition, and the primary resonant frequency in the condition of not restraining, a hit ball sound can be made [sound / near] into a consonance or it by considering the resonant frequency of the oscillation mode in which the SOL section which has the big influence as the pronunciation section at the time of a hit ball is uneven as consonant relation.
[0043] It is desirable to set to 1:n (for n to be or more 3 five or less integer) the ratio of the primary resonant frequency in the condition of having restrained the center section of the face section, and the resonant frequency in the oscillation mode related to the face section in the condition of the head concerned of not restraining. That is, the resonant frequency in the oscillation mode related to the face section is made into 3 times of the primary resonant frequency in a restricted condition, 4 times, or 5 times. In addition, the case of less than 3.0**0.2 times, less than 4.0**0.2 times, and less than 5.0**0.2 times is also real identitas. Here, "the oscillation mode related to the face section" is the oscillation mode (for example, mode 5 shown in drawing 14) in which the face section is uneven.
[0044] Also in this case, while making consonant relation the primary resonant frequency in a face restricted condition, and the primary resonant frequency in the condition of not restraining, a hit ball sound can be made [sound / near] into a consonance or it by considering the resonant frequency of the oscillation mode in which the face section which has the big influence as the pronunciation section at the time of a hit ball is uneven as consonant relation.
[0045] Moreover, a hit ball sound can be further brought close to a consonance by considering the resonant frequency of the oscillation mode in which the SOL section is uneven with the resonant frequency of the oscillation mode in which the face section is uneven as the primary resonant frequency in a face restricted condition and the primary resonant frequency in the condition of not restraining, and consonant relation. For example, a hit ball sound can be made [sound / near] into a consonance or it by setting to 1:2:3:4 the resonant frequency in the oscillation mode related to the face section in the primary resonant frequency and the primary

condition of not restraining in the oscillation mode related to a resonant frequency, the primary resonant frequency in the condition of not restraining, and the SOL section in the condition of not restraining in a face restricted condition.
[0046]
[Example] Hereafter, the example of this invention is explained using drawing 1 - drawing 16 .
[0047] Drawing 1 is the perspective view of the head 1 of the metal wood golf club in the example 1 of this invention. Drawing 2 is the sectional view of the head 1 of drawing 1 . In addition, since a shaft and the thing of the common knowledge as a grip are employable, illustration and explanation are omitted in this application specification.
[0048] As shown in drawing 1 and drawing 2 , the head 1 of this invention is equipped with the face section 2, the crown section 3, the side section 4, and the SOL section 5, and consists of titanium or a titanium alloy. What is necessary is to carry out forging shaping of each parts which constitute the face section 2, the crown section 3, the side section 4, and the SOL section 5, and just to join these parts by welding etc., in order to produce this head 1. Moreover, what is necessary is just to connect this head 1 with a shaft and a grip by the well-known technique, in order to produce the golf club of this invention.
[0049] In this example, as an example of a standard head, 300cm, the volume mentions the head whose thickness of 1.0mm and the SOL section 5 the thickness of 1.0mm and the side section 4 is [the thickness of 3 and the face section 2] 1.2mm for the thickness of 2.8mm and the crown section 3, and changes various parameters, such as thickness of each part of this head, and an elastic modulus of an ingredient.
[0050] In order to evaluate the oscillation mode and the natural frequency of this standard head in a detail, various kinds of oscillation modes and the natural frequency of the head concerned were computed by setting up the thickness of each part, and the elastic modulus of that ingredient using the characteristic value analysis software of the finite element method of above-mentioned pro-MEKANIKA (PANAME trick technology corporation company make), as shown in Table 1 and Table 2, and setting up a constraint. In addition, all specific gravity was set to 4.83.
[0051]
[Table 1]

ケース		1a	1b	2a	2b	3a	3b	4a	4b
		標準的なヘッド		フェース肉厚 down		クラウン肉厚 up		フェース部弾性率 down	
拘束の 有無		フェース拘束	拘束なし	フェース拘束	拘束なし	フェース拘束	拘束なし	フェース拘束	拘束なし
各部の肉厚 (mm)	フェース	2.8	←	2.52	←	2.8	←	2.8	←
	クラウン	1	←	1	←	1.2	←	1	←
	ソール	1.2	←	1.2	←	1.2	←	1.2	←
	サイド	1	←	1	←	1	←	1	←
材料の弾性率 (GPa)	フェース	103	←	103	←	103	←	82	←
	クラウン	103	←	103	←	103	←	103	←
	ソール	103	←	103	←	103	←	103	←
	サイド	103	←	103	←	103	←	103	←
固有振動数 (Hz)	モード1	1058	1937	962	1927	1045	2043	965	1925
	モード2	1919	2615	1907	2612	2025	2688	1905	2603
	モード3	2576	3194	2569	3192	2647	3191	2563	3186
	モード4	3122	3548	3114	3546	3118	3553	3101	3544
	モード5	3521	3903	3518	3846	3521	4004	3516	3758
	モード6	3942	4531	3903	4441	3968	4604	3826	4393
	モード7	4622	4940	4575	4910	4706	5021	4508	4894
固有振動数比	b1/a1		1.83		2.00		1.96		1.99
	b2/a1		2.47		2.72		2.57		2.70
	b3/a1		3.02		3.32		3.05		3.30
	b4/a1		3.35		3.69		3.40		3.67
	b5/a1		3.69		4.00		3.83		3.89
	b6/a1		4.28		4.62		4.41		4.55
	b7/a1		4.67		5.10		4.80		5.07

[0052]
[Table 2]

ケース		1a	1b	5a	5b	6a	6b	7a	7b
		標準的なヘッド		フェース肉厚up		クラウン肉厚down		フェース弾性率up＆他down	
拘束の 有無		フェース拘束	拘束なし	フェース拘束	拘束なし	フェース拘束	拘束なし	フェース拘束	拘束なし
各部の肉厚(mm)	フェース	2.8	←	3.36	←	2.8	←	2.8	←
	クラウン	1	←	1	←	0.6	←	1	←
	ソール	1.2	←	1.2	←	1.2	←	1.2	←
	サイド	1	←	1	←	1	←	1	←
材料の弾性率(GPa)	フェース	103	←	103	←	103	←	124	←
	クラウン	103	←	103	←	103	←	82	←
	ソール	103	←	103	←	103	←	82	←
	サイド	103	←	103	←	103	←	82	←
固有振動数(Hz)	モード1	1058	1937	1228	1946	1083	1692	1120	1752
	モード2	1919	2615	1932	2617	1675	2426	1740	2357
	モード3	2576	3194	2583	3198	2389	3203	2322	2866
	モード4	3122	3548	3133	3551	3141	3513	2812	3177
	モード5	3521	3903	3531	3964	3527	3596	3150	3634
	モード6	3942	4531	3999	4680	3782	4185	3670	4260
	モード7	4622	4940	4698	5004	4108	4637	4325	4526
固有振動数比	b1/a1		1.83		1.58		1.56		1.56
	b2/a1		2.47		2.13		2.24		2.10
	b3/a1		3.02		2.60		2.96		2.56
	b4/a1		3.35		2.89		3.24		2.84
	b5/a1		3.69		3.23		3.32		3.24
	b6/a1		4.28		3.81		3.86		3.80
	b7/a1		4.67		4.07		4.28		4.04

[0053] The oscillation modes at the time of constraint are the modes 1-7 shown in drawing 3 - drawing 9 , and the oscillation modes at the time of un-restraining are the modes 1-7 shown in drawing 10 - drawing 16 . In these drawings, a continuous line shows the head 1 before deformation, and the broken line shows an example of the condition after deformation of each part of a head.
[0054] The resonant frequency at the time of face constraint of the above-mentioned standard head serves as a value shown in 1a and 1b of Table 1 and 2, and the value of the ratios b1/a1 of the primary resonant frequency (mode 1) of face center-section constraint and the primary resonant frequency (mode 1) of the head in the condition of not restraining is 1.83, and does not necessarily have consonant relation.
[0055] Then, if the thickness of the face section 2 is lowered ten percent like 2a of Table 1, and 2b, the value of the ratios b1/a1 of the primary resonant frequency at the time of face center-section constraint and the primary resonant frequency of the head in the condition of not restraining can be set to 2.0. Moreover, even if it thickens thickness of the crown section 3 twenty percent, as shown in 3a and 3b of Table 1, the value of the ratios b1/a1 of the primary resonant frequency at the time of face center-section constraint and the primary resonant frequency of the head in the condition of not restraining can be set to about 2.0. In addition, although not shown in Table 1, the value of the above-mentioned ratio can be set to about 2 by

thickening thickness similarly to not only the crown section 3 but the side section 4, or the SOL section 5.

[0056] Even if it lowers the elastic modulus of the face section 2 as a means which lowers the rigidity of not only the thickness of each part but the face section 2 as mentioned above, the value of the above-mentioned ratios b1/a1 can be set to about 2 like 4a and 4b of Table 1. Even if similarly it gathers the elastic modulus of the crown section 3, the side section 4, or the SOL section 5 as a means which raises the rigidity of parts other than face section 2, the value of the above-mentioned ratio can be set to about 2. Moreover, the both sides of the thickness of each part of a head 1 and the elastic modulus of each part can be changed, and the value of the above-mentioned ratio can also be set to about 2.

[0057] In addition, it is also effective for there to be an approach by heat treatment as an approach of lowering the modulus of elasticity of each part in the case of a titanium alloy, and to change the ingredient itself into titanium and magnesium from aluminum from the aluminum from titanium and steel. In order to gather the elastic modulus of each part, an approach contrary to these can be considered. That is, in the case of a titanium alloy, there is an approach by cold treatment, and it is possible to change the ingredient itself into aluminum from the steel from the titanium from aluminum, and titanium, and magnesium.

[0058] Next, if the thickness of the face section 2 is raised twenty percent as shown in 5a and 5b of Table 2, the value of the ratios b1/a1 of the primary resonant frequency at the time of face center-section constraint and the primary resonant frequency of the head in the condition of not restraining can be made into the value near 1.5. Moreover, as shown in 6a and 6b of Table 2, even if it lowers the thickness of the crown section 3 40 percent, the value of the above-mentioned ratio can be made into the value near about 1.5.

[0059] Not only the thickness of each part but by gathering the elastic modulus of the face section 2, or lowering the elastic modulus of parts other than face section 2, as shown in 7a and 7b of Table 2, the value of the above-mentioned ratio can be made into the value near 1.5. Moreover, it is also possible to make the value of the above-mentioned ratio into the value near about 1.5 by adjusting both the thickness of each part and the elastic modulus of each part.

[0060] In addition, it is possible to carry out the value of ratios b1/a1 within the limits of 1.5**0.1 by adjusting the thickness and the elastic modulus of a head 1 appropriately in the example shown in Table 2, although there is nothing within the limits of 1.5**0.1 about the value of ratios b1/a1.

[0061] Although drawing 12 and the modes 3 and 4 at the time of un-restraining [which is shown in 13] correspond to the oscillation mode of the SOL relation which is the mode in which the SOL section 5 mainly vibrates As by thickening thickness of the crown section 3 suitably shows to 3a and 3b of Table 1 A resonant frequency primary [setting to about 2.0 the value of the ratios b1/a1 of the primary resonant frequency at the time of face constraint, and the primary resonant frequency of the head in the condition of not restraining and / at the time of face constraint], The value of the ratios b3/a1 with the resonant frequency (mode 3: SOL-related oscillation mode) of Miyoshi of the head in the condition of not restraining can be set to about 3.0.

[0062] As shown in 5a and 5b of Table 2, moreover, by thickening thickness of the face section 2 suitably A resonant frequency primary [setting to about 1.5 the value of the ratios b1/a1 of the primary resonant frequency at the time of face constraint, and the primary resonant frequency of the head in the condition of not restraining and / at the time of face constraint], The value of the ratios b4/a1 with the fourth resonant frequency (mode 4: SOL-related oscillation mode) of the head in the condition of not restraining can be set to about 3.0.

[0063] Although the modes 5-7 at the time of un-restraining [which is shown in drawing 14 - 16] correspond to the oscillation mode of the face relation which is the mode in which the face section 2 mainly vibrates As by lowering the elastic modulus of the face section 2 suitably shows to 4a and 4b of Table 1 A resonant frequency primary [setting to about 2.0 the value of the ratios b1/a1 of the primary resonant frequency at the time of face constraint, and the primary resonant frequency of the head in the condition of not restraining and / at the time of face constraint], The value of the ratios b7/a1 with the seventh resonant frequency (mode 7: face-

related oscillation mode) of the head in the condition of not restraining can be set to about 5.0.
[0064] As shown in 6a and 6b of Table 2, moreover, the primary resonant frequency at the time of face constraint, The value of the ratios b1/a1 with the primary resonant frequency of the head in the condition of not restraining can be set to about 1.5, and the value of the ratios b6/a1 of the primary resonant frequency at the time of face constraint and the seventh resonant frequency (mode 7: face-related oscillation mode) of the head in the condition of not restraining can be set to about 4.0.
[0065] Moreover, as by thickening thickness of the crown section 3 appropriately shows to 3a and 3b of Table 1 A resonant frequency primary [setting to about 2.0 the value of the ratios b1/a1 of the primary resonant frequency at the time of face constraint, and the primary resonant frequency of the head in the condition of not restraining and / at the time of face constraint], The value of the ratios b3/a1 with the resonant frequency (mode 3: SOL-related oscillation mode) of Miyoshi of the head in the condition of not restraining is set to about 3.0. A resonant frequency further primary [at the time of face constraint], The value of the ratios b7/a1 with the seventh resonant frequency (mode 7: face-related oscillation mode) of the head in the condition of not restraining can be set to about 5.0.
[0066] As shown in 7a and 7b of Table 2, furthermore, the primary resonant frequency at the time of face constraint, A resonant frequency primary [setting to about 1.5 the value of the ratios b1/a1 with the primary resonant frequency of the head in the condition of not restraining and / at the time of face constraint], A resonant frequency primary [setting to about 3.0 the value of the ratios b4/a1 with the fourth resonant frequency (mode 4: SOL-related oscillation mode) of the head in the condition of not restraining and / at the time of face constraint], The value of the ratios b7/a1 with the seventh resonant frequency (mode 7: face-related oscillation mode) of the head in the condition of not restraining can be set to about 4.0.
[0067] In addition, although the above-mentioned example explained the case where the ratio of the primary resonant frequency in the face restricted condition of a head 1 and the primary resonant frequency in the condition of the head concerned of not restraining was set to 1:2 or 2:3, naturally it is also possible to set the above-mentioned ratio to 3:4 by adjusting appropriately the thickness and the quality of the material of each part of a head 1.
[0068] Although the gestalt and example of operation of this invention were explained as mentioned above, it should be thought that the gestalt and example of operation which were indicated this time are [no] instantiation at points, and restrictive. The range of this invention is shown by the claim and all modification in a claim, equal semantics, and within the limits is included.
[0069]
[Effect of the Invention] According to this invention, the sound emitted from the head of a restricted condition and the sound emitted from the head in the condition of not restraining can be carried out [sound / a consonance or / of relation close to it] by adjusting appropriately the relation between the primary resonant frequency in the restricted condition of a head, and the primary resonant frequency in the condition of a head of not restraining. Specifically, the sound emitted from the head of a restricted condition and the sound emitted from the head in the condition of not restraining can be considered as the relation of an octave, or the relation of pure 5 degree. Therefore, it can make [sound / near] a hit ball sound into a consonance or it, and it not only can obtain a comfortable hit ball sound, but can make easily hit ball actuation and a judgment of the right and wrong of an RBI.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view of the metal wood golf club head of this invention.
[Drawing 2] It is the sectional view of the metal wood golf club head of this invention.
[Drawing 3] It is the mimetic diagram showing the deformation condition of the head in the primary oscillation mode (mode 1) at the time of restraining a face center section.
[Drawing 4] It is the mimetic diagram showing the deformation condition of the head in the secondary oscillation mode (mode 2) at the time of restraining a face center section.
[Drawing 5] It is the mimetic diagram showing the deformation condition of the head in the oscillation mode (mode 3) of Miyoshi at the time of restraining a face center section.
[Drawing 6] It is the mimetic diagram showing the deformation condition of the head in the fourth oscillation mode (mode 4) at the time of restraining a face center section.
[Drawing 7] It is the mimetic diagram showing the deformation condition of the head in the fifth oscillation mode (mode 5) at the time of restraining a face center section.
[Drawing 8] It is the mimetic diagram showing the deformation condition of the head in the sixth oscillation mode (mode 6) at the time of restraining a face center section.
[Drawing 9] It is the mimetic diagram showing the deformation condition of the head in the seventh oscillation mode (mode 7) at the time of restraining a face center section.
[Drawing 10] It is the mimetic diagram showing the deformation condition of the head in the primary oscillation mode in the condition of a head of not restraining (mode 1).
[Drawing 11] It is the mimetic diagram showing the deformation condition of the head in the secondary oscillation mode in the condition of a head of not restraining (mode 2).
[Drawing 12] It is the mimetic diagram showing the deformation condition of the head in the oscillation mode (mode 3) of Miyoshi in the condition of a head of not restraining.
[Drawing 13] It is the mimetic diagram showing the deformation condition of the head in the fourth oscillation mode in the condition of a head of not restraining (mode 4).
[Drawing 14] It is the mimetic diagram showing the deformation condition of the head in the fifth oscillation mode in the condition of a head of not restraining (mode 5).
[Drawing 15] It is the mimetic diagram showing the deformation condition of the head in the sixth oscillation mode in the condition of a head of not restraining (mode 6).
[Drawing 16] It is the mimetic diagram showing the deformation condition of the head in the seventh oscillation mode in the condition of a head of not restraining (mode 7).
[Description of Notations]
1 A head, 2 The face section, 3 The crown section, 4 The side section, 5 The SOL section, 6 Neck section.

[Translation done.]